the perturbations, from the observations made at the comet's appearance in the summer of 1819. He infers from his researches upon Winnecke's comet a value for Encke's force designated by U, differing little from that assigned by Encke from his discussion of the motion of his comet, the more satisfactory considering that much latitude must be allowed in this direction. He further observes that with $U = \frac{1}{900}$ the effect upon the motion of Faye's comet would be so small that it is necessarily mixed up with uncertainty in the values of the perturbations; it will be remembered that Prof. Axel-Möller, who has laboured so admirably to follow up with every precision the motion of Faye's comet, has not, since his computations assumed their present refined form, been able to detect any abnormal effect upon it.

With regard to a diminution in the mass of Jupiter it is to be remarked that all the newer reliable determinations have confirmed the value deduced by Bessel from the elongations of the satellites, including that inferred by Prof. Krueger from the perturbations of Themis, and that which Dr. Axel-Möller has found from his researches on the motion of Faye's comet. Such diminution, therefore, appears inadmissible.

THE IMPERIAL OBSERVATORY, STRASSBURG.—In a communication to the *Astronomisches Gesellschaft* Prof. Winnecke has given details of the construction and instrumental equipment of this new establishment, which we cannot doubt, under his skilful and energetic direction, is destined to take its place amongst the most prominent of astronomical institutions. The principal instruments are—(1) the meridian circle, with object-glass of 6·4 inches aperture, which has been constructed by Repsold and was completed several years since; (2) the alt-azimuth, of 5·35 inches aperture and 4·9 feet focal length, also by Repsold; (3) the refractor, of 19·2 inches aperture and 23 feet focal length, by Merz, but mounted by Repsold, the object-glass being found to be of great excellence; (4) an "orbit-sweeper," constructed according to the design of Sir George Airy, as explained in the *Monthly Notices* of the Royal Astronomical Society, vol. xxi. p. 158; this is, so far as we know, the only instrument of the kind yet mounted, and has been used for some time by Prof. Winnecke in the provisional observatory at Strassburg; the aperture of the object-glass is 6·4 inches, which is not greater than it is essential to provide for the advantageous use of the peculiar mounting. We may hear of the application of the "orbit-sweeper" to the search (which it is not too soon to commence) for the comet of 1812, and later on for Olbers' comet of 1815, neither of which bodies will admit of accurate prediction. A plan of the buildings and grounds accompanies Prof. Winnecke's notice in the *Vierteljahrsschrift*.

THE COMPANION OF SIRIUS.—Mr. Burnham publishes mean results of numerous measures of the small companion of Sirius made with the 18-inch refractor at Chicago in the years 1877–80. We subjoin them with the errors indicated for Prof. Auwers' ephemeris in his *Untersuchungen über veränderliche Eigenbewegungen*:—

Epoch.	Position.	Error of ephemeris.	Distance.	Error of ephemeris.
1878·01	52°·4	+6°·0	10″·83	−0″·78
1879·13	50·7	+5·5	10·44	−0·77
1880·11	48·3	+5·7	10·00	−0·72

METEOROLOGICAL NOTES

AMONG the interesting papers which appear in the *Annales du Bureau Central Météorologique de France* for 1878 there is one by Prof. Hildebrandsson, of peculiar value, On the Freezing and Breaking-up of the Ice on the Lakes, the Epochs of Vegetation, and the Migration of Birds in Sweden, based on the observations made by a numerous staff of observers scattered over the country. The paper is illustrated by a diagram showing the seasonal distribution of temperature for ten of the more typical climates of Sweden, and by twelve maps indicating the geographical distribution of the physical and biological phenomena under discussion. Since the lakes of Sweden, which occupy a twelfth part of its entire superficies, exert powerful and diverse influences on plant and animal life, according as they are frozen or open, special attention has been directed to their examination. The results show that while the lakes in the extreme south are covered with ice on an average of ninety days in the year, those in the extreme north are 230 days bound with ice. The average date of the freezing of the lakes in the north is October 10, whereas in the south this does not take place till December 10. On the other hand, the ice breaks up in the southern lakes on April 1, but in the north not until the first week of June. The maps show the decided manner in which the curves are deflected and modified by such extensive sheets of water as are presented by Lakes Wener, Wetter, and Maelar, by height above the sea, and by the Atlantic in different seasons. During the freezing of the lakes the south-west winds of the Atlantic attain a maximum force and frequency, and under this influence the high lakes to westward of the head of the Gulf of Bothnia do not freeze till November 30, or six weeks later than the lakes in the same latitude near Haparanda. On the contrary, at the time of the breaking-up of the ice in spring, easterly winds are prevalent, and the ice on the lakes near the head of the Gulf of Bothnia breaks up four weeks earlier than that of the more elevated lakes to westward. An interesting examination is made of the dates of the breaking-up of the ice on Lake Maelar at Westerås from 1712 to 1871, and from a comparison of the averages of each of the ten-year periods it is seen that the earliest was April 14 for the decade 1722-31, and the latest, May 5, for 1802-11. Whilst the results for these 160 years indicate considerable fluctuations, they give no countenance to the idea that any permanent change has taken place in the climate of Sweden. Three maps show the number of days in which the plants that flower in the extreme south in April, and those in May, come successively into bloom, and the leafing of trees occurs at different places on advancing northward. As regards the plants which come into bloom in the south in April, their time of flowering is forty-five days later at the head of the Gulf of Bothnia, and sixty days later in the elevated districts to westward, but as regards the plants which bloom in the south in May, the times are only twenty-five and thirty-five days. The curves of the May flowers are closely coincident with the curves representing the breaking-up of the ice of the lakes. The time taken for the advance northward from the south to the head of the Gulf of Bothnia is twenty-three days for the leafing of trees and the flowers of May, whereas the time taken by the April flowers is forty-three days. The curves showing the times of arrival of four of the more marked of the migratory birds differ much from each other. The lark arrives in the south on March 1, and in the north on May 1, and the arrangement of the curves of arrival closely agrees with the curves showing the breaking-up of the ice of the lakes but a month earlier. As regards however the wild goose, the cuckoo, and the woodcock, the curves showing their arrival assume a different form, and point to an intimate connection subsisting between the arrivals and the temperature of the place at which they arrive.

To mark the high value they set on carefully-made observations, the Council of the Scientific Association of France have awarded medals to Lieut. Pouvreau, serving on the line from Havre to New York, Lieut. Benoît, of the *Yang-Tsé*, plying between Marseilles and Shanghai, and Captain Corenwinder, of the *Grenadier*, Dunkirk, for the meteorological observations made by them, these comprising, in addition to the usual observations, numerous and elaborate notes on whirlwinds and other special phenomena. At the same time a medal was awarded to M. Vidal, schoolmaster at Fraisse, Hérault, for a peculiarly interesting series of observations made by him during the past fifteen years, regularly in winter as well as in summer, at a height of 3,150 feet above the sea. M. Vidal has also, from his wide and varied knowledge of the natural sciences, rendered effective service to scientific men in their excursions into the higher districts of that part of France.

PROF. FORNIONI has recently described to the Istituto Lombardo (*Rendiconti*, vol. xiii. fasc. 3) a simple nefodoscope, or instrument for measuring the direction of motion of clouds (the instrument of the kind known as that of Braun being thought expensive and inconvenient to use). It consists of a flat compass case with pivoted needle, above which is fixed horizontally a plane mirror occupying the whole of the case. On the surface of the glass are drawn diagonal lines corresponding to the rise of winds. The amalgam is removed in a narrow arc extending from north to north-west, so that the end of the needle may be seen for the purpose of orientation, and this transparent arc is graduated. A rod with terminal eye, freely pivoted on the edge of the case, completes the instrument. When the direction of a given cloud is to be determined, the nefodoscope is placed in a horizontal plane and properly oriented. The rod

is then moved to such a position that the observer's eye sees three points in a straight line, viz., the eye of the rod, the centre of the mirror, and the reflected image of a selected point of the cloud. The direction of the displacement which the latter undergoes after a time, proportional to the velocity of the cloud and inversely as its distance, is the required direction.

THE Report of the Royal Society of Tasmania for 1878 includes the tri-daily meteorological observations made at Hobart Town by Mr. Francis Abbott, so long an enthusiastic observer there, together with the annual abstract of his observations, and also an annual abstract of observations made by Mr. W. E. Shoobridge at New Norfolk, situated about fifteen miles from Hobart Town, higher up the Derwent. Observations were formerly made at Port Arthur, Swansea, Swan Island, and Kent's Group, viz., from 1861 to 1866, but at present Hobart Town and New Norfolk appear to be the only meteorological stations in the colony, the observations at Hobart Town dating from 1841, and those at New Norfolk from 1874. Mr. Abbott prints also his daily observations made at 10.33 P.M. in connection with Gen. Myer's international synchronous observations, the importance of which we have several times had occasion to refer to in describing the United States weather maps. The regular hours of observation are 7.30 A.M. and 4.30 P.M., these hours having been adopted since 1876, as stated in the Report, with the view of assimilating the records more closely with those of stations in Europe, America, &c., in order to co-operate in a system of international meteorology. These hours have not been happily chosen for general meteorological purposes, particularly since it is the practice to adopt as the mean temperatures of the separate months simply the mean of the observations at the above hours, which, whilst only very slightly below the true mean during the winter months, are from $1^\circ\cdot5$ to $2^\circ\cdot8$ too high for the four warmest months of the year.

PHYSICAL NOTES

AT the last meeting of the Physical Society of Paris some new and curious experiments upon the so-called magic mirrors of Japan were shown by M. Duboscq and discoursed upon by M. Bertin. Mirrors having a sufficiently true surface to give a fairly good virtual image of an object held near to them may yet be very irregular in the actual curvature of the surface and produce a very irregular real image of a luminous point reflected by the mirror upon a screen. If such a mirror be warmed the thinner portions change their curvature, becoming flatter, and yield dark corresponding patches in the disk of reflected light. A mirror which gives very imperfect effects when cold will give very good ones when heated. If, by means of a condensing pump, a uniform pressure is exerted against the back of the mirror, the thinner portions are more affected than the thick portions, and therefore, as viewed from the front, become less concave than the rest of the surface, the result upon the reflected beam being that the pattern of the thicker parts comes out bright on the darker ground of the image. Lastly, if a mirror be *cast* upon the face of the original mirror, and then polished, it will when warmed become a "magic" mirror, though when cold it yields only a uniformly illuminated disk upon the screen. This last experiment alone suffices to show that the cause of the reputed magical property is to be sought not in any difference of reflective power in different parts of the surface, but in slight differences of curvature of the surface.

A NEW zinc-carbon battery, the patent of Mr. R. Anderson, is announced. The exciting liquid is a mixture of hydrochloric acid, bichromate of potash, and of certain other "salts" in a mixture, for the composition of which Mr. Anderson claims the protection of the patent. The battery may be used either with or without a porous cell. It is stated that the E.M.F. of this battery is as high as 2·15 volts, that it is remarkably free from local action and internal resistance, and that it is very constant, one cell having twelve square inches of effective surface of the zinc, giving for seventy hours a constant current.

MR. A. A. MICHELSON, of the U.S. Navy, has communicated to the New York Academy of Sciences some interesting observations upon the diffraction and polarisation effects produced by passing light through a narrow slit. If a fine adjustable slit be narrowed down very greatly, the coloured diffraction fringes widen out until when the width of the slit is reduced to less than one-fiftieth of a millimetre, the central space only is seen, and appears of a faint bluish tint. Moreover, the light so transmitted exhibits traces of polarisation when regarded through a Nicol prism. If the slit is still further narrowed, the depth of the tint and the amount of polarisation increase, until, when a width of only one-thousandth of a millimetre is reached, the colour becomes a deep violet and is perfectly polarised. In this experiment the Nicol prism may be used either as polariser or as analyser. Slits of iron, brass, and obsidian produce identical results, though with the latter material, which can probably be more finely worked, the effects are the most pronounced. The polarisation is in a plane at right angles to the length of the slit. The phenomenon is best observed by using direct sunlight, placing the slit as near the eye as possible, and analysing with a double-image prism, thus enabling the delicate changes of tint to be observed by comparison. The possible explanation that the light which thus comes through the slit is reflected at its edges accords with the direction of the plane of polarisation; but there remains the difficulty that these effects should take place with all widths of slit and vary with the nature of the materials. One important point is that a slit of this degree of fineness admits the shorter waves of light more freely than the longer waves.

LORD RAYLEIGH showed a curious experiment in colour-combinations to the Physical Society, when he produced a yellow liquid by mixing a blue solution of litmus with a red solution of bichromate of potash. We recollect a kindred experiment which is even more curious, namely, the production of white by the mixture of crimson and green. An aqueous solution of cuprous chloride and a solution of rosaniline acetate in amylic alcohol are placed in a bottle in certain relative quantities. The crimson solution floats upon the green solution. But when shaken up together both colours disappear, and the mixture is simply a turbid greyish white.

MR. PREECE's new microphone or telephone transmitter has at least the merit that it surpasses all others for simplicity. A very thin wire stretched between two points forms part of a circuit containing a Bell telephone and a small battery. When it is set vibrating by sounds, the vibrations, by varying the strain to which it is subjected, alter its conductivity, probably by producing alterations in its temperature.

M. OBALSKI describes a pretty magnetic curiosity to the Académie des Sciences. Two magnetic needles are hung vertically by fine threads, their unlike poles being opposite one another. Below them is a vessel containing water, its surface not quite touching the needles. They are hung so far apart as not to move towards one another. The level of the water is now quietly raised by letting a further quantity flow in from below. As soon as the water covers the lower ends of the needles they begin to approach one another, and when they are nearly immersed they rush together. The effect appears to be due to the fact that when the gravitation force downwards is partly counteracted by the upward hydrostatic force due to immersion, the magnetic force, being relatively greater, is able to assert itself.

THE phenomenon of luminosity of a (especially) negative electrode of small surface used in electrolysis of, *e.g.*, acidulated water, has been investigated by Prof. Colley of Kasan (*Jour. de Phys.*, May). Examining the light (which Slouguinoff found associated with an intermittence of the current) with a rotating mirror, he saw on a weakly luminous ground a multitude of bright star-like points, each appearing only an instant, and distributed without apparent regularity. The spectrum of the negative electrode was found to be composed of bright lines, determined both by the liquid and the substance of the electrode. Some physicists have thought that the electrode is considerably heated, and that the liquid round it assumes the spheroidal state, being separated by a layer of vapour. M. Colley finds that with a very strong current the electrode indeed becomes incandescent, and the liquid ceases to moisten it. He shows, however, that the illumination may be produced on an electrode quite cold, and he seeks the cause of production of vapour (of which he supposes the isolating layer to consist) in the high temperature of the liquid immediately surrounding the electrode (not in that of the electrode itself), heat being developed by reason of the small surface and small conductivity of a thin sheath of liquid. With a pile of 100 Bunsen couples, water containing 5 per cent. of sulphuric acid, and an electrode of 10 sq. mm. surface, 1·3 seconds would suffice to raise the layer next the electrode from 20° to 100° C. The sheath of gas